

ULTRAVIOLET LIGHT MEASURING CHIP AND ULTRAVIOLET LIGHT SENSOR USING THE SAME

BACKGROUND OF THE INVENTION

The present invention relates to an ultraviolet light measuring chip comprising a first reaction chamber for receiving the total light and a second reaction chamber for receiving the light with the ultraviolet light cut off to measure the amount of ultraviolet light, and an ultraviolet light sensor including the ultraviolet light measuring chip for calculating the amount of ultraviolet light electrochemically.

The light having a wavelength in the range of 400 to 770 nm is called visible light which is visible to human eyes. In this wavelength range, the light having the shortest wavelength of about 400 nm is violet light, and the light in proximity to the violet light and having a still shorter wavelength is called the ultraviolet light. The ultraviolet light are of three types. One is the UV-A wave in the wavelength range of 320 to 400 nm having the property of attacking the corium partially through the epidermis cuticle and causing wrinkles and bags. The second type of ultraviolet light is called the UV-B wave having a wavelength of 290 to 320 nm. The UV-B wave, which is interrupted by the epidermis cuticle and causes the skin cancer, spots or freckles, has the strongest effect on the human skin. The third type of the ultraviolet light is called the UV-C wave which has a wavelength of 290 nm or less. The UV-C wave, which is mostly absorbed into the ozone layer, has an effect on genes and causes the skin cancer. The visible light having the longest wavelength is the red light having a wavelength of about 760 nm. The light having a longer wavelength than 760 nm is called the infrared light. The infrared light having a short wavelength of about 760 nm is called the near infrared light, and the infrared light having a long wavelength of 50 to 1000 μ m is called the far infrared light. The last-mentioned light is used for heating or the like purposes and is an energy wave most easily absorbed into the human being.

The most harmful one of the lights described above is the ultraviolet light. The ultraviolet light has an effect on the human skin as described above including a serious effect changing the skin tissue to a morbid state and a lighter effect commonly seen in our daily life. Specifically, when melanocyte (pigment cell) contained in the skin is exposed to ultraviolet light, the melanin pigment is produced so that the skin is blackened or formed with spots or freckles. On the other hand, the most serious effect that leads to morbidity is the fact that the ultraviolet light damages the genes in the nuclei of the skin cells and develops a cancer. Normally, genes, even when partially damaged, are healed by counteracting enzymes. In the case where a strong sunburn or wound is caused by a great amount of exposure, however, the recovery by enzymes is so insufficient that cells develop a mutation and lead to a cancer in many cases.

The chlorofluoro hydrocarbon gas, which has been widely used for a long time as an apparently stable, superior refrigerant carrier, has been discharged into the atmosphere without sufficient verification and has come to destroy the ozone layer covering the atmosphere of the earth. The ozone layer has the important function of cutting off the ultraviolet light showered on the earth and thus protecting the living creatures. As the result of destruction of the ozone layer, the ultraviolet light has increasingly come to reach the surface of the earth, and has caused increased cases of skin cancer,

thus greatly affecting the living creatures. The morbidity rate of the skin cancer in Japan has increased from one for each about 100 thousand persons in the 1960s and 1970s to about 5 per 100 thousand persons at present. This rate change is regarded as a considerable increase though still remarkably small as compared with 800 per 100 thousands in Australia and 250 per 100 thousands in the U.S.A. It is also reported that a 1% decrease of ozone increases ultraviolet light by 2% and skin cancer cases by 3 to 5% ("Medical Renaissance", by Masamitsu Ichihashi, published by Yomiuri Shimbun (on-line).

A study was made of the percentage of which skin cancer cases represent the outpatients who visited the departments of dermatology of 24 university-attached hospitals throughout Japan in the 1970s and 1980s. Comparison between the 1970s and the 1980s shows that the number of skin cancer patients in the 1980s suffering from basal-cell carcinoma at the same level as the lowest layer of the epidermis increased by 17% and patients of solar keratoderma, a skin precancerous, characterized by red or black speckles and sores of the skin increased by 84%. Therefore, children playing freely in daylight or outdoor, which is an important factor for growth, are adversely affected after being exposed to a great amount of sunlight for long hours in sports or recreation, indicating the necessity of protection against the ultraviolet light by wearing shirts of long sleeves or applying anti-sunburn cream. Especially, patients of xeroderma pigmentosum, who suffer from an extreme sunburn even under a small amount of ultraviolet light and have a hereditary defect in the enzyme system for repairing the genes damaged by the ultraviolet light, are liable to be attacked by cancer at the rate 1000 to 2000 times higher than normal people, and therefore require a very careful measure for protection against the ultraviolet light.

An experiment indicating the great importance of protection against the ultraviolet light is being conducted by Professor Masamitsu Ichihashi, Kobe University. In the experiment, two sisters, 4 and 2 years old, suffering from xeroderma pigmentosum were thoroughly instructed to take a protective measure against the ultraviolet light by applying an anti-sunburn cream and wearing a hat and thus to guard against the effect of the ultraviolet light. In this way, a follow-up check was conducted to determine the degree to which the preceding unprotected period different by two years between them relates to the production of cancer. Both of the two sisters finally came to suffer from cancer, the elder sister at the age of 13 and the younger sister at the age of 23. In other words, the elder sister who had been exposed to ultraviolet light without protection for two years longer in her infancy developed cancer 10 years earlier. This indicates how it is important to protect against the ultraviolet light. In addition, the ultraviolet light adversely affects the immune mechanism of the skin. An animal experiment has proved that the immunity of the whole body is reduced by the radiation of the ultraviolet light thereby to increase the tendency of suffering from an infectious disease.

The reduced immunity cannot eliminate cancer cells, if any are developed. A research conducted in the U.S.A. reports that under the exposure to the ultraviolet light four times larger in amount than an assumed reference at which the skin becomes slightly reddish, the immunity of 40% of ordinary persons and 95% of skin cancer patients failed to work normally.

In Europe and America, the danger of sunburn is widely known. In Japan, where most of the skin cancer cases are old people, the period before the cancer develops is in most cases longer than when younger people suffer. Generally,